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INVESTIGATION OF POLLUTION OF THE AIR OF TEXTILE MILLS OF CAPRON POLYAMIDE FIBER PRODUCTION ENTERPRISES

A. T. Kotlovoi

Environmental Protection Agency
Research Triangle Park, North Carolina

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INVESTIGATION OF POLLUTION OF THE AIR OF TEXTILE MILLS OF CAPRON POLYAMIDE FIBER PRODUCTION ENTERPRISES

[Issledovaniye zagryazneniy vozdushnoy sredy tekstil'nykh tsekov predpriyatiy po proizvodstvu poliamidnogo volokna kapron]

by

A. T. Kotlovoy,
All-Union Scientific Research Institute of Glass Fibers

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In the processes of spinning and thermosetting of capron fibers, the air of textile mills becomes polluted with harmful substances. The condition of the air of textile mills of enterprises depends on a number of conditions: Characteristics of the technological process, machinery construction, the presence and air-tightness of local housings, efficiency of local and general ventilation, the spinning compounds used, etc.

Spinning compounds differ in heat resistance [1]. The thermosetting treatment of capron fibers is accompanied by decomposition of the compounds, reduction in fiber quality and emission of harmful substances

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into the environment [2-4]. Air in the premises can contain large amounts of harmful substances [5]. This has served as a basis for carrying out investigations of the qualitative and quantitative nature of pollution of the air of textile mills, ventilation discharges and industrial areas, as well as evaluation of different types of machinery, as to generation of gas in use of compound BV and heat-resistant Teprem-6 spinning emulsion.

Chemical-hygienic investigations have shown that, in heating compound BV under conditions close to those of industry, a mixture of volatile substances is given off into the air, consisting of an oily aerosol, ammonia, ethyl alcohol, cyclohexanol, etc. Determination of BV in the air was carried out by the emulsion method, according to oily aerosol content.

Carbon monoxide, Teprem-6 aerosol, formaldehyde, acetaldehyde, ethylene oxide, hydrogen, carbon dioxide and others have been detected in the volatile products of Teprem-6. Investigation of the air for content of volatile products of Teprem-6 was based on determination of formaldehyde and organic substances oxidized to formaldehyde by periodic acid. The total content of the latter is determined by the method of [6], based on the reaction of formaldehyde with a solution of chromotropic acid or its disodium salt.

This investigation was carried out, under the conditions of operation of NDT-1 (Dobson-Barlow Company) and KVSh-250K capron cord spinning machines and TK-300, FE-125I, Scragg Company and BG-2404 machinery for thermosetting of bulk filaments of elastic, meron and flock. Results of analyses of the air of capron plant textile mills are presented below:

Concentration of Air Pollution (in mg/m^3) vs. Machine Type

Compound	NDT-1	KVSh-250K	Scragg Co.	FE-125I	TK-300	BG-2404
BV	8.82	3.57	9.70	8.40	4.66	5.20
Teprem-6	0.01	0.01	0.02	0.01	0.01	Not studied

The KVSh-250K machine is hygienically more nearly perfect than the NDT-1 machine, and it is designed for high productivity. At the same time, the design of the local coverings of the thermoelectric plasticizers of the KVSh-250K machine has a significant deficiency. Inadequate sealing of the heater housings and imperfections in the local exhaust ventilation facilitates discharge of oily BV aerosol in the upper and lower areas of the machine. The average oil aerosol concentration in the upper part of the machine is 6.15 mg/m^3, it reaches 10.15 mg/m^3 in the lower part and 8.82 mg/m^3 in the breathing area.

The maximum concentration of oily BV aerosol in the working area of the NDT-1 machine is close to 20 mg/m^3. Therefore, there was practical interest in evaluating the two types of machines in production of the Teprem-6 capron compound. The results of the study showed that the average concentration of harmful substances at the level of the breathing zone of workers on the KVSh-250K and NDT-1 machines was not over 0.01 mg/m^3 (maximum permissible concentration for Teprem-3 is 20 mg/m^3, according to some data [7], and 0.15 mg/m^3, according to others). In heat treatment of the capron cord fiber in the NDT-1 machine, the concentration of caprolactam in the air of the mill fluctuated from 0.6 to 1.8 mg/m^3 (MPC [8], 10 mg/m^3).

The highest concentration of harmful substances given off by the BV compound was found in the working area of the Scragg Company machine (9.7 mg/m^3). This is explained by the high volatility of the mineral oil base compounds and by the absence of local exhaust ventilation at the machine. In thermosetting of filaments in type FE-125I machines, an oil aerosol is given off into the air. The average concentration of the oily BV aerosol is 8.4 mg/m^3.

The most favorable air conditions were found in production of bulk fiber in the TK-300 machines, which are distinguished by high productivity. It was determined that the content of BV aerosol in the bulk fiber mill was 4.6 mg/m^3 on the average and, of Teprem-6, 0.01 mg/m^3 (see above).

Based on data obtained over a number of years, it can be concluded that the use of the heat-resistant Teprem-6 spinning emulsion facilitates improvement of working conditions in production of polyamide fibers for various purposes.

There are no data in the literature on pollution of the air of exhaust ventilation systems of textile mills and industrial areas of factories; therefore, for comparison, investigations were carried out as to the degree of air pollution in these places by volatile components of the BV and Teprem-6 compounds. Discharges of the local exhaust ventilation of NDT-1 and TK-300 machines were investigated, and analysis of the air at various distances from the pollution sources also was carried out (table). Before discharge to the atmosphere of the air sucked out of the NDT-1 machine heater housings, the oil was cleaned out of it in condensors.

Content of harmful substances (in mg/m^3) in the air of exhaust ventilation systems and at different distances from pollution sources

a Препараты	b В вентиляционных выпускных системах		c На расстоянии от источника выбросов			
			5 м		50 м	
	пределы колебаний e	средний d	пределы колебаний e	средний d	пределы колебаний e	средний d
БВ f . . .	0,61—1,15	1,16	0—0,66	0,15	0—0,13	0,10
Теprем-6 g .	0,02—0,08	0,01	0,003—0,031	0,0009	0,003—0,012	0,001

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Key: a Compounds
b In exhaust ventilation systems
c Limits
d Average
e Distance from discharge sources
f BV
g Teprem-6

[Translator's Note: Commas in tabulated figures are equivalent to decimal points.]

Oily aerosols of the BV compound enter the atmosphere from discharges of the local exhaust ventilation of NDT-1 and TK-300 machines. It should be noted that, with the existing system of cleaning the air in condensors, the ventilators and air ducts are contaminated with oil and fibers broken away during spinning to a considerable extent, which can create a fire hazard.

The results of the investigations, carried out under conditions of industrial production of capron cord fiber and bulk filaments, are evidence of the advisability of replacement of compounds with low resistance by heat resistant spinning emulsion Teprem-6.

1. The level of air pollution of textile mills, ventilation discharges and industrial areas, using the BV and Teprem-6 compounds in production of polyamide capron fiber, was investigated. It was shown that the degree of pollution of the air of industrial premises, in use of

Teprem-6 is below the permissible limit. A low content of volatile products of Teprem-6 was found in the atmosphere, at distances up to 50 m from the discharge source.

2. The heat-resistant spinning emulsion, Teprem-6, is recommended for widespread introduction into production of capron fibers of various types.

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